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IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

Applicant : DIRK SELDESLACHTS

Serial No : 09/051,565

For : DEVICE FOR REMOVING
UNWANTED VOLATILE
COMPOUNDS FROM BEER WORT

DECLARATION

I, the undersigned, Stéphane DUPIRE, a Belgian citizen, residing at rue Bawin, No2, ORP-LE-GRAND, BELGIUM, do hereby depose and say :

that I am :

- a Doctor of Science from LOUVAIN Catholic University, LOUVAIN (LEUVEN), BELGIUM,

and that I have been and I am working as follows :

- Guest professor of Brewing Technology at LOUVAIN Catholic University ;

- Member of Brewing Science Group of European Brewing Convention ;

- Member of American Society of Brewing Chemists ;

- Former member of Analysis Committee of European Brewing Convention ;

- Research Manager of INTERBREW Company, Vaarstraat 94, B-3000 LEUVEN, BELGIUM, since 1986.

I declare that I am considered as a specialist in the technical field of Brewing methods and technology.
I am familiar with the method and device for removing unwanted volatile compounds from beer wort disclosed in the above referenced US Patent Application and have read said US Patent Application including the Office Actions issued therein.

I have also studied attentively the various prior art documents cited during the examination procedure of the above-mentioned US Patent Application.

1 - The principles of a method and a device for stripping a descending current of beer wort in counter current with an ascending current of steam or inert gas have been disclosed in the US-A-4,550,029 to KRUGER claiming a priority in Germany of July 7, 1981 and published on October 29, 1985.

The method by KRUGER undoubtedly discloses an improvement with respect to the conventional wort brewing method mentioned in column 1, lines 12-20 thereof which was necessitating an amount of steam for the pre-heating and boiling processes of approximately 15 to 20 kilos per hectolitre of wort, i.e. a ratio by weight of steam over wort of approximately 15 to 20%.

It is interesting to mention here that KRUGER discloses a steam consumption of 15 to 20 kilos per litre of wort, which is a completely aberrant figure.

KRUGER discloses a tray column within which, as disclosed in column 2, lines 4-9, the inert gas and/or steam is repeatedly in contact with the wort. Accordingly, this method especially provides an advantageous movement of the wort by the formation of vapour bubbles. Because of desorption, undesirable volatile components are simultaneously discharged.

It is also mentioned, in column 3, lines 21 to 30, that "the rising steam from the sump region 6 flows intensively through the wort as the wort flows downward from plate to plate and causes considerable movement of the wort and an intensive formation of the vapour bubbles therein, etc. The wort is simultaneously heated...and kept in boiling condition for such a

period of time until it is degassed by the rising flow of steam and is freed of undesirable foreign substances".

Very unfortunately, KRUGER gives no indication whatsoever concerning steam consumption and volatile components elimination ratio.

2 - It must be explained here some general information about stripping :

- a) The stripping efficiency is all the more high since the gas/liquid contact surface area is higher and the gas or steam flow rate entering the column is higher. Similarly, the higher the column, the better the stripping efficiency.

- b) Generally speaking, stripping columns loaded with filler bodies are known to provide a better stripping efficiency than tray columns, in connection with the fact that in columns loaded with filler bodies, the liquid or suspension to be stripped is in a much more divided state than in a tray column.

- c) In an industrial installation, it is always necessary to limit the costs, on one hand the investment costs, in particular the diameter and the height of a stripping column, on the other hand, the running costs, in particular the ratio of steam or inert gas over wort.

- d) It is sure that it is possible to obtain an excellent stripping efficiency in a high column using a high steam or inert gas over wort ratio and providing a very large gas/liquid contact surface area. The running costs and investment costs of such a column would in general make a stripping operation industrially and economically unacceptable.

3 - Special difficulties are met in case of stripping a beer wort.

- a) Beer wort is an unstable suspension containing impurities which may easily settle. More importantly, beer wort is also a suspension which has a great tendency to foaming, particularly when in a very divided state, so that in case of stripping of beer wort, there will be in a column loaded with filler bodies a much higher tendency of the wort to foaming than in a tray column.

- b) As mentioned in the description in the above-referenced Patent Application, in page 4, lines 20 to 24, the first tests carried out by our company with a conventional stripping column have shown bad and unsatisfactory results in particular a low DMS elimination ratio of 60% to 70% making it impossible to prepare from the obtained wort a beer of a taste and a quality acceptable by the consumers.

- c) In particular, the high tendency of the wort to foaming when in a divided state resulted in a big volume of foam occupying the whole internal volume of the column, thereby greatly perturbating the liquid/gas contact conditions and leading to low liquid flow rate and bad and low stripping efficiency.

- d) In order to control wort foaming, the present inventor had to go in the direction opposite to that recommended by KRUGER and to avoid systematically any intensive flow of the steam through the wort, any considerable movement of the wort, any intensive formation of vapour bubbles in said wort.

4 - The method and the device disclosed in the above-referenced Application provide the very surprising and unexpected result that within a stripping column equipped with internal appliances providing a low gas/liquid contact surface area it is possible to obtain a quite satisfactory DMS elimination ratio using a very low steam flow rate corresponding to a very low steam to wort ratio of about 1.5%, more generally between 0.5 and 3%, for a very satisfactory wort flow rate.

5 - As a matter of fact, and for avoiding the main risks of wort foaming, the present inventor has selected for the column upper zone an upper distributing plate having orifices for the passage of wort and upstanding chimneys for the passage of steam, thereby distributing regularly and uniformly the wort across the whole cross-section of the column while separating completely wort from steam and accordingly considerably decreasing the contact therebetween in this zone.

Similarly it appeared necessary to use a filler body of relatively large diameter and of correspondingly relatively low exchange surface area per unit volume, thereby reducing wort/steam exchanges.

Moreover, it was desirable to load the filler bodies in bulk directly on the bottom plate and to eliminate the racks in which said filler bodies are conventionally loaded in order to make it possible to very rapidly remove said racks containing said filler bodies to empty the stripping column for cleaning purposes.

In addition, it appeared desirable to have the bottom plate supporting the filler bodies to have orifices with a total passage area equivalent to 90 or 100% of the total cross section area of the column, thereby maximising the passage of the wort and the steam but minimising wort/steam contact in this zone. Under this plate, an inclined plate recovers the wort avoiding his fall, which would increase the foam.

Surprisingly and unexpectedly, it appeared that all efforts made to eliminate any risk of foaming of the wort which undesirably lead to decrease steam/wort contact conditions made it possible to obtain reliably and reproducibly a DMS elimination ratio of more than 85% with a steam consumption of about 1 or 1.5%.

More precisely, each one of the efforts made to minimise wort foaming have rendered smoother the liquid/gas or steam contact conditions and have improved the stripping yield, thereby unexpectedly and synergistically making it possible to decrease the gas/steam flow rate and to increase the wort flow rate until reaching the above-mentioned figures without any detrimental effect on the DMS elimination ratio.

6 - It is worth comparing here the results obtained by the present inventor to those disclosed in the WO 95/26395 and discussed in the present description, from page 2, line 20, to page 4, line 11; i.e. a stripping ratio of 5% for a wort flow rate of 1200 l/h treated in a 12 plates tray column.

7 - Usually, and as disclosed in the description of the above-referenced Application, in page 17, lines 9-12 and 17-21, the pressure inside the column is measured and used to determine the boiling temperature of the wort at said pressure. The wort entering the column will be preheated to said boiling temperature. Similarly, the steam introduced in said column will be saturated steam at said pressure. Accordingly, there will be no steam

condensation for heating the wort, and no wort boiling which would uselessly consume energy. As a matter of fact, should the wort have to be heated in the column, this would be done by a part of the packing which would become inefficient for the stripping.

Should an inert gas be used instead of steam, said inert gas would be introduced substantially at the same temperature as the wort.

In any case, the temperature of the wort shall be the boiling temperature of said wort at the pressure present inside the column.

8 - None of the cited and applied references teaches or suggests the following specific claimed limitations :

- to introduce in the column the wort at a temperature equal to the boiling point of said wort at the pressure inside the column;

- to organize the gas/liquid exchanges and to select column internal appliances organizing such exchanges, so as to avoid any significant formation of foam.

- to provide a bottom plate comprising a number of orifices such that a total surface area through which said current of inert gas or steam passes upwardly and said current of wort passes downwardly is equal to at least 90% of a transverse surface area of the column.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true ; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Stéphane DUPIRE

December 12th, 2000.